

Having described the invention, we claim:

*Sub  
city*

1. An apparatus for helping to protect a vehicle occupant, comprising:

an actuatable vehicle occupant protection device; and

a microelectromechanical system device, <sup>defining</sup> (MEMS device) energizable to cause actuation of said protection device.

2. An apparatus as set forth in claim 1 wherein said MEMS device is an energizable fluid source for emitting a primary fluid for actuating said protection device.

3. An apparatus as set forth in claim 2 wherein said protection device is an inflatable device and said apparatus includes means for directing said primary fluid from said MEMS device into said inflatable device to inflate said inflatable device.

4. An apparatus as set forth in claim 3 comprising a plurality of said MEMS devices and including means for directing said primary fluid from said MEMS devices into said inflatable device to inflate said inflatable device, said plurality of MEMS

devices being individually actuatable to control inflation of said protection device.

5. An apparatus as set forth in claim 4 wherein said plurality of MEMS devices are individually actuatable at different times to control inflation of said protection device.

6. An apparatus as set forth in claim 4 wherein said plurality of MEMS devices are individually actuatable to control the direction of inflation of said protection device.

7. An apparatus as set forth in claim 2 wherein said MEMS device includes a solid pyrotechnic material which is ignited upon energizing of said MEMS device to produce said primary fluid.

8. An apparatus as set forth in claim 2 wherein said MEMS device includes a quantity of fluid under pressure which is heated upon energizing of said MEMS device to cause emission of said primary fluid.

9. An apparatus as set forth in claim 1 wherein said actuatable vehicle occupant protection device

includes a rupturable portion and said MEMS device is energizable to rupture said rupturable portion.

10. An apparatus as set forth in claim 9 comprising at least one additional MEMS device which is energizable to help to rupture said rupturable portion.

11. An apparatus as set forth in claim 1 comprising a plurality of said MEMS devices and including means for selectively controlling whether and when each one of said MEMS devices is energized.

12. An apparatus as set forth in claim 2 comprising means for directing said primary fluid from said MEMS device to a secondary fluid source to actuate said secondary fluid source to provide secondary fluid for actuating said protection device.

13. An apparatus as set forth in claim 12 wherein said MEMS device is at least a portion of an initiator for an augment inflator.

14. An apparatus as set forth in claim 12 wherein said MEMS device is at least a portion of an initiator for a heated gas inflator.

15. An apparatus comprising:
- an actuatable vehicle occupant protection device;
  - at least one multi-layered device including:
    - an outer layer having a plurality of individually rupturable segments;
    - a middle layer having a plurality of individual chambers associated in a one-to-one relationship with said rupturable segments of said outer layer and being closed by said rupturable segments, each one of said chambers having contents heatable to increase the pressure in said chamber; and
    - a base layer having a plurality of individually energizable electric heating elements associated in a one-to-one relationship with said chambers for, when energized, heating the contents of said chambers;
  - each one of said rupturable segments being rupturable due to an increase in pressure in its associated chamber to enable flow of fluid out of said chamber; and
  - means for selectively energizing said individually energizable electric heating elements.

Approved for Release

16. An apparatus as set forth in claim 15 wherein said heatable contents comprises a pyrotechnic material which is ignitable to produce fluid under pressure.

17. An apparatus as set forth in claim 15 wherein said heatable contents comprises a fluid under pressure which is heatable to increase its pressure.

18. An apparatus as set forth in claim 15 wherein said electric heating elements are micro-resistors.

19. An apparatus as set forth in claim 15 wherein said protection device is an air bag.

20. An apparatus as set forth in claim 15 wherein said multi-layered device is an initiator for a fluid-generating apparatus.

21. An apparatus as set forth in claim 15 wherein said multi-layered device is energizable to generate a primary fluid for actuating said protection device.

22. An apparatus as set forth in claim 15 wherein said electric heating elements are reactive bridges.

23. An apparatus comprising,  
an inflatable vehicle occupant protection device; and  
an inflator for inflating said protection device,  
said inflator comprising an actuatable primary inflation fluid source for providing inflation fluid, a secondary inflation fluid source, and at least one microelectromechanical system device (MEMS device) energizable to produce combustion products for actuating or augmenting said primary inflation fluid source.

24. An apparatus as set forth in claim 23 wherein said inflator is a heated gas inflator, said actuatable primary inflation fluid source is a fluid mixture comprising an inert gas component and a fuel gas component, and said MEMS device is energizable to produce combustion products for igniting said fuel gas component of said fluid mixture.

25. An apparatus as set forth in claim 23 wherein said actuatable primary inflation fluid source comprises stored gas and said MEMS device comprises an ignitable solid material actuatable to produce

26. An apparatus as set forth in claim 23 wherein said inflator comprises a plurality of MEMS devices including said one MEMS device energizable to produce combustion products for igniting or augmenting said primary inflation fluid source, and further comprising electric circuitry means for energizing selected ones of said plurality of MEMS devices to control the fluid output of said inflator.

27. An apparatus comprising:  
an actuatable vehicle occupant protection device;  
an array of individually energizable devices for producing one of inflation fluid or combustion products for actuating said protection device; and  
means for energizing selected ones of said array of individually energizable devices,  
said means for energizing comprising a base that extends across said array and that includes a plurality of electric heating elements associated one with each of said energizable devices,  
said means for energizing further comprising control means for directing electric current into

selected ones of said plurality of electric heating elements to energize said selected ones of said energizable devices.

28. An apparatus as set forth in claim 27 wherein said electric heating elements are resistors made using a CMOS process.

29. An apparatus as set forth in claim 27 wherein said heating elements are micro-resistors.

30. An apparatus as set forth in claim 27 wherein said individually energizable devices are pyrotechnic devices ignitable to produce inflation fluid under pressure.

31. An apparatus as set forth in claim 27 wherein said individually energizable devices are fluid devices energizable to produce inflation fluid under pressure.

32. An apparatus as set forth in claim 27 wherein said electric heating elements are reactive bridges.

ADD A/D

add B27